Art. XIII.—*Phosphate Fertilisers.*

By BRENDA SUTHERLAND, B.Sc.

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The most important artificial manures used in Australia are those supplying phosphorus. Potassium and nitrogen applications are of occasional value only, but even small quantities of superphosphate may double or treble the yield. Experiments have shown superphosphate to be more effective than either bone dust or basic slag, but it remains to be seen if superphosphate is the best obtainable fertiliser. It, of course, precipitates as normal calcium phosphate in the presence of soil lime, and always tends to sour the soil. A neutral fertiliser in which this precipitation did not occur might be less deleterious and more effective, because more readily available.

Metaphosphates and pyrophosphates were the most obvious compounds to try, as the results obtained from them by previous investigators seemed indecisive. Eggertz and Nilson (Bied. Cent., 1893) gives potassium metaphosphate as being two per cent. less effective than potassium dihydrogen phosphate. Nilson (Bied. Cent., 1894) gives potassium metaphosphate and potassium orthophosphate as equally effective, and Märcker (Bied. Cent., 1895) records that potassium metaphosphate gave good results with barley. The original papers were not available, but, judging from the abstracts, the authors do not state which polymer of potassium metaphosphate was used. There are six polymers known, and among them trimetaphosphate (which is difficult to obtain and therefore not likely to have been used), is sharply marked off by the solubility of all its salts. So while all the other metaphosphates would, by double decomposition with the calcium carbonate of the soil, produce insoluble calcium salts, calcium trimetaphosphate would remain in solution, and so be immediately available.

Field experiments were therefore run, in which sodium orthophosphate, sodium pyrophosphate, and sodium trimetaphosphate were compared with one another, and with ordinary superphosphate. For the management of the plots I have to thank Mr. Whelan, Field Officer, and Mr. Adcock, Principal of the Ruther-

glen Viticultural College. They were arranged in four sets, planted respectively with early and late wheat, and early and late oats. Each set contained nine plots, of which four were check plots, not fertilised at all, and the remaining five were dressed with different phosphates, as shown in the accompanying table. The application was in each case such that the phosphorus pentoxide applied would be equal to a dressing of good superphosphate at 100 pounds to the acre. The fertiliser was sowed with the seed, except in one case, in which it was applied as a top dressing in the spring.

The area of each plot was 106 links by 5 links, and of this three links at either end was discarded on harvesting, so that the area on which results were based was 100 links by 5 links (=1-200th acre). The results are given as total produce per acre, cut when ripe enough for grain. The increase by manuring is reckoned as the difference between plot considered and adjacent check plot. (In the case of superphosphate take the average of the check plots on either side.)

Fertiliser	Federation Wheat (early ripening)		College Eclipse Wheat (later ripening)		Brown Oats (very early ripening)		Algerian Oats (later ripening)	
	Acre Yield.	Increase.	Acre Yield.	Increase.	Acre Yield.	Increase.	Acre Yield.	Increase.
	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.
Nil - - -	412	-	725	-	575	-	575	-
Metaphosphate (applied with seed)	578	166	981	256	1075	500	875	300
Metaphosphate (top dressed in Spring)	459	53	778	66	662	37	700	125
Nil - - -	406	-	712	-	625	-	575	-
Pyrophosphate (applied with seed)	543	137	803	91	800	175	800	225
Orthophosphate (applied with seed)	600	157	862	150	825	250	787	262
Nil - - -	443	-	712	-	575	-	525	-
Superphosphate (applied with seed)	631	154	946	228	812	212	862	262
Nil - - -	512	-	725	-	625	-	675	-

The four main points to be noted in the tabulated figures are :—

(1) Metaphosphate gives in all cases a better crop than superphosphate, but with some plots the difference is negligible.

(2) Pyrophosphate is in every case less satisfactory than superphosphate.

(3) Metaphosphate applied as a top dressing in spring does very little good. Apparently the value lies in the initial start to the very young plant.

(4) In the case of brown oats, which grow rapidly, the advantage of using metaphosphate is very marked. This suggests that further experiments might be tried to find its value with rapidly growing crops, vegetables, etc.

We unfortunately lost the opportunity of determining yield of grain as distinct from total produce. The plants were damaged by a tornado to an extent which made threshing impossible. This point, and the question as to whether composition and quality of the grain is altered by the use of metaphosphate, are still unapproached.

In conclusion I desire to express my thanks to Dr. Heber Green, in whose department I worked, for continued advice and assistance.